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ABSTRACT

In the first section of this paper, the author analyzes concepts and theoretical issues found to be significant for the topics of investigation but neither sufficiently explicated nor fully incorporated into the studies to be described later. It is felt that much further work needs to be done in order to achieve such goals. In the second section, a cross-linguistic psychological analysis is described which contributes a prerequisite for the following, more complex investigations of bilingual behavior. In the third section, these investigations are reported which explore implicit and explicit response tendencies in intralingual and interlingual performance. In the fourth section, psychological difficulties in translation, especially problems of rearrangements or interlingual transformations, are investigated. (Author/AMM)

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PSYCHOLOGICAL STUDIES IN BILINGUAL PERFORMANCES AND CROSS-LINGUISTIC DIFFERENCES

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PSYCHOLOGICAL STUDIES OF BILINGUAL PERFORMANCES AND CROSS-LINGUISTIC DIFFERENCES[1]

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Concepts and theoretical issues found to be significant in psychological studies of bilingual performance and cross-linguistic differences but which are neither explicated nor incorporated in studies described in later portions of this paper are analyzed in the first section. In the second section, a cross-linguistic psychological analysis is described which contributes a prerequisite for the following, more complex investigations of bilingual behavior. In the third section, those investigations are reported which explore implicit and explicit response tendencies in intralingual and interlingual performance. Finally, in the fourth section, psychological difficulties in translation, especially problems of rearrangements of interlingual transformations, are investigated.

Congruent with the main purpose of these investigations, the following report summarizes theoretical explorations and psychological research on cross-linguistic differences, bilingualism, and second-language learning. In part it incorporates earlier work by the present author. Whenever this is done, reference to reports previously published will be made.

In the first section, we analyze concepts and theoretical issues found to be significant for the topics of investigation but neither sufficiently explicated nor fully incorporated into the studies to be described later. Much further work needs to be done in order to achieve such goals. In the second section, a cross-linguistic psychological analysis is described which contributes a prerequisite for the following, more complex investigations of bilingual behavior. In the third section, these investigations are reported which explore implicit and explicit response tendencies in intralingual and interlingual performance. In the fourth section, psychological difficulties in translation, especially problems of rearrangements or interlingual transformations, are investigated.

Theoretical Considerations of Cross-linguistic Differences and Bilingualism

Types of bilingual conditions. If we look from the outside at bilingual situations, we analyze--what might be called--bilingual ecologies. Let us assume that an individual is exposed to two languages with vocabularies of size A and B, respectively. Theoretically, any word in the vocabulary A could be contextually related to any other word in A. Thus, the number of possible combinations or simple relations in A equals A x A or A^2. The same is true for B. However, a bilingual individual will also be burdened with interlingual relations between A and B as well as between B and A. Theoretically there are A x B possible combinations for each of the two directions. Therefore, the bilingual speaker might be exposed to four times as many relations than the monolingual speaker, i.e., $(A + B)^2$ instead of A^2. Since his vocabulary might be only twice as large as for a monolingual, i.e., A + B instead of A, a comparison of the relative growths of his vocabulary with his repertoire of relations allows us to draw specific inferences about the language acquisition process.

Disregarding the fact that only a few of all possible combinations between elements are realized within or between any of the two languages, the answer to the question of whether a bilingual child will, indeed, acquire four times as many relations as a monolingual child depends upon the environmental, linguistic conditions in which he finds himself. Subsequently, and shown in Figure 1, different types of bilingualism can be distinguished. On one extreme we find, for instance, an orphan who has been raised within one linguistic community and, after losing his family has been raised within a new linguistic setting in which his first language is not known. The child will retain his native language for a certain period of time but, because of disuse, is likely to lose it over the years. A bilingual individual of this type will be exposed to and will become partially familiar with the intralingual sets of relations in both A and B but with practically none of the interlingual relations connecting the two languages. This type of language behavior might be called independent bilingualism.

Insert Figure 1 about here

At the other extreme, we find children who are exposed to a linguistic environment in which two languages are almost randomly mixed. Conditions like these are approximated in the slang of Spanish-American ghettos in New York and Los Angeles or among the lower class Japanese-Americans or Chinese-Americans in Hawaii. The emerging type of language behavior might be called confounded bilingualism. Early psychological research has consistently pointed to the inferior performance levels of such children in both languages and, subsequently, has contributed to the rather negative attitude toward bilingualism among many educators and behavioral scientists, not to mention the public at large. Aside from the fact that most of these children are socially and culturally deprived to begin with, the following inspection of our diagram makes their deficiencies in comparison to their age-mates in monolingual settings plausible.

If we assume that a child, during a given period of time, can acquire a specific amount of psycholinguistic information or knowledge, represented, for instance, by a small subsection of our diagram of Figure 1, the unfavorable conditions of the ghetto child become clearly apparent. Keeping all other factors constant, e.g., intelligence, motivation, stimulation of the environment, etc., he distributes his efforts over all four quadrants of the diagram and, thus, receives only 1/4 of the relational information a monolingual child would be able to receive in his language and only 1/2 of the information which a child raised under independent bilingual conditions could receive in his two languages. Thus, the environmental contingencies of the confounded bilingual conditions are clearly disadvantageous to the child. No wonder that his performance is lower and that he may never catch up with his more fortunate age-mates.

Since there will always be some positive transfer from the first to the second language, a completely separated exposure to two languages, as under the independent bilingual contingencies, is not ideal either. Therefore, educators have always attempted to find a compromise between these two extreme conditions, generally by reducing the set of interlingual relations to a minimum, i.e., to the two sets of equivalence relations, $A \rightarrow B$ and $B \rightarrow A$. The condition in which some but not all interlingual relations are invoked will be called coordinated bilingual condition (see Figure 1B), even though this term has been used in a different sense by Ervin and Osgood (1965).

Under coordinated bilingual conditions the teacher builds upon the well developed first language system by introducing a small set of interlingual relations, namely equivalence relations, such as TABLE → TISCH. Thus, much of the knowledge in the first language might be transferred to the second language, especially, if both belong to the same language family. Of course interference is also likely. At other occasions, special audio-visual techniques introduce extralingual relations in order to aid the acquisition of equivalence relations and of the second language in general. Since also first language learning is initiated and supported by extralingual relations (such as by overt labelling of objects and by demands and commands for actions) second language acquisition might utilize a dual connectivity as indicated in Figure 2.

Insert Figure 2 about here

In extending our argument, eventually we need to explore whether instructions under coordinated bilingual conditions ought to be narrowly restricted to equivalence relations. Of course, and as shown already, precise, one-to-one equivalence relations or translations hardly ever exist for any two languages. Perhaps for this reason alone, second-language teachers ought to consider much more forcefully a wide variety of semantic and conceptual relations between two languages. In some of the studies to be described, for instance, we taught second language learners not only narrow equivalence relations, such as TABLE → TISCH, but also class names to the stimulus (MÖBEL), coordinates (STUHL, SCHRANK), parts (BEIN), etc. The facilitating effects of such conceptual equivalence training was striking and enabled the student to proceed much more freely and reasonably within the second-language system.

Statistical growth models: As shown in investigations of literary texts (Herdan, 1960) and of first language acquisition (Riegel, 1966), the total amount of linguistic input (or output) is logarithmically related to the amount of linguistic information, i.e., to the number of different relations. The longer the text, the more redundant it will become. The uncertainty is high only at the beginning.

If we apply the growth models thus derived to the study of bilingual development we have to take account of the following special parameters (aside from those concerning the overall size of the repertoire and the rate of exposure): Proportional prevalence of the first vs. the second language ($p + q = 1.0$), time of shift into the bilingual environment (t_o), and type of environmental conditions (independent vs. confounded, or any intermediary condition).

In one of our previous papers (Riegel, 1968b) various growth curves have been determined and estimates of the environmental utility have been derived. Utility coefficients are defined by integral ratios, the nominator of which represents the bilingual growth curve for different values of the parameters mentioned and the denominator, the monolingual growth curve. By means of these coefficients questions can be answered on the optimum time for initiating second language training, the time at which the second language will become dominant, the efficacy of the two bilingual conditions, the burden placed upon Ss under confounded conditions, the decline with age in the possibility of mastering a second language, etc.

Admittedly, these explorations simplify and idealize the practical bilingual situations. For more realistic approximations at least the following factors need also be considered in addition to the three parameters mentioned: (a) the degree of similarity between the two languages which will both cause transfer and interference, perhaps differentially in regard to phonetic, semantic, or syntactic aspects and in regard to the age of Ss. (b) The variation in the type of linguistic environments from day to day or over longer and stable periods of the life span, such as between baby talk, playground talk, school language, professional language, etc. (With de Saussure [1931], such variations within one language might be called "paroles" in distinction from the language in general, "la langue"). (c) Psychological rather than physical, environmental contingencies which will allow to make differential predictions concerning the perception, storage retrieval and production of language. (d) The high redundancies of the relational systems (i.e., the fact that only a few of all possible relations might occur and need to be realized by the learner) which reduce the total amount of information necessary to achieve efficient communication in either one or both languages.

Levels of bilingual development: The two types of bilingual conditions can be regarded as extremes of a developmental sequence of five levels with the independent condition at the beginning and the confounded condition at the endpoint. Seen in this way, the child in a confounded bilingual environment, such as in a ghetto, is overburdened with an advanced type of input incongruent with his intellectual maturity and characterized by the failure to maximize the independence of the first and second languages within the whole relational system. Without exception, the separate utilization of these two subsystems remains the primary goal of language training even though the interconnections might be important for a fuller, contrastive comprehension of both languages.

Level I characterizes the very early steps in the acquisition of the first language by which parts of the vocabulary A are acquired on the basis of extralingual relations. Thus, the interconnections are of a special type, namely between words and the objects, events, or qualities which they denote. The number of these extralingual relations, placed into the cells of the main diagonal of the A x A matrix, is equal to or less than A. At Level I, no second language is acquired, thus B = 0.

At Level II, various interconnections in A will be learned. Theoretically, each item could be connected with all other items and (as at Level I) with the object, event or quality which it denotes. Thus, the maximum number of relations will be A^2. At this level, too, B = 0.

At Level III, parts of a vocabulary B are acquired on the basis of equivalence relations. Equivalence relations appear on the main diagonals of the two interlingual quadrants of Figure 1 and connect items in B to their translations in A and vice versa. Thus, the total vocabulary equals A + B, but it is likely that $B \rightarrow A$. The total number of possible relations equals $A^2 + 2B$, whereby the second term refers to the equivalence relations $A \rightarrow B$ and $B \rightarrow A$. The number of equivalence relations going in either direction may be unequal, if the two languages differ in the size of their repertoires. Level III resembles Level I and is of great importance for the initiation of second-language learning, i.e., for acquiring information such as "In German, table is called tisch." This type of learning will be quickly supplemented by more complex forms of language behavior. Under independent bilingual conditions and as a function of the teaching technique applied, Level III may be substituted (or supplemented) by a modified form of Level I relating the vocabulary items of the second language to the objects, events, or qualities which they denote rather than to their translated labels. In this case, the set of relations equals $A^2 + B$ rather than $A^2 + 2B$.

At Level IV, items in B are also interconnected. The relations with A remain of the equivalent type. Thus, the total vocabulary equals A + B, whereby B may approach A, and the total number of relations consist of those in A, those in B and the equivalence relations $A \rightarrow B$, and $B \rightarrow A$, that is, $A^2 + B^2 + 2B$. The extralingual relations might be placed along the main diagonal of the second language matrix, represented by the term B^2. If they do not appear, the above expression should be reduced by B. In any case, Ss may derive the extralingual relations in B without further instructions on the basis of the extralingual relations in A and the equivalence relations $A \rightarrow B$ and $B \rightarrow A$.

At Level V, all items are interconnected. The vocabulary remains $A + B$. The number of relations equals $A^2 + B^2 + 2AB = (A + B)^2$. The proficiency of most bilinguals will remain at Level IV, but under exceptional circumstances Level V may be attained. Moreover, it is conceivable that $A = B$ or $A \neq B$, both for the languages to be learned as well as for those portions already learned.

The above levels must be regarded as transitional periods in a continuous process of change. They overlap greatly. Thus, while an individual continues to realize extralingual relations, he may already explore intralingual relations between the items of his first vocabulary. Also, while still acquiring equivalence relations, he will be exposed to intralingual relations within his second language or to interlingual relations between the two languages. Taking all these variations into account, most psycholinguists will, nevertheless, agree that Level II follows I and Level IV follows III. However, III may be substituted by a special condition, whenever the second language is introduced by extralingual rather than equivalence relations. Level V either follows II or IV or co-occurs with them, whenever both languages are simultaneously introduced under confounded conditions. Thus, the five levels--much like current "stage" theories of development--meet the requirement of partially ordered scales.

Degrees of bilingual proficiency: The discussion of bilingual types and levels can be extended to account for variations in bilingual performance. If we view the matrices of Figure 7 as representing all possible inter-item combinations, i.e., relations, we realize that in concrete testing situations and depending upon Ss' second-language proficiency, various intervening steps might occur. Denoting equivalence relations by double arrows (⇒), all other relations by single arrows (→), left and right-hand terms of relations (stimuli and responses) by capital letters (S,R), and intervening terms by lower case letters (s,r), the following inferences can be drawn.

For intralingual performances in the first language (represented by the left upper square of Figure 7), the occurrence of intervening steps is unlikely except for reasons related to a general theory of mediational processes, thus,

$$S_A \rightarrow R_A$$

For intralingual performances in the second language (represented by the right lower square of Figure 7) at least the following paradigms need to be considered:

(a) Subjects operate exclusively within the second language system:

$$S_B \rightarrow R_B$$

(b) Subjects implicitly translate the stimulus, then associate into the second language:

$$S_B \Rightarrow s_A \rightarrow R_B$$

(c) Subjects implicitly associate into the first language, then translate their implicit responses:

$$S_B \rightarrow r_A \Rightarrow R_B$$

(d) Subjects implicitly translate the stimulus, implicitly associate in their first language, then translate their implicit response:

$$S_B \Rightarrow s_A \rightarrow r_A \Rightarrow R_B$$

Three paradigms are conceivable for each of the two interlingual conditions represented by the lower left and upper right squares of Figure 7:

$$S_A \rightarrow R_B \qquad\qquad S_B \rightarrow R_A$$

$$S_A \rightarrow s_B \Rightarrow R_B \quad \text{and} \quad S_B \Rightarrow r_B \rightarrow R_A$$

$$S_A \Rightarrow r_A \rightarrow R_B \qquad\qquad S_B \rightarrow s_A \Rightarrow R_A$$

It seems reasonable to propose that the greater a person's second-language proficiency, i.e., the more he "thinks in the second language", the smaller the number of intervening steps. Subjects' overall reaction time, for instance, will increase with the number of intervening steps and thus, when applied as experimental treatments, e.g., in word association studies, the four intralingual and interlingual conditions can serve to estimate the lengths of the various fractions of reaction time that enter into Ss' overall performance either in an additive or in any other manner and, in general, can serve to measure Ss' proficiency. It is questionable whether an increase in response variability can also be expected. Response variability does not only increase with the number of intervening steps but is also dependent upon the size of the second-language vocabulary. Since the size of the vocabulary increases as the number of intervening steps decreases, i.e., with language proficiency, it may counteract any potential decrease in response variability. The significance of all these factors and their interactions as well as their dependence on the age of Ss, on types and levels of bilingualism, etc., need to be tested by empirical means.

Equivalence relations: Our discussion of bilingual conditions, development and performances has been considerable simplied by assuming that equivalent terms are related in a one-to-one manner to each other. As Catford (1965) convincingly shows, this is hardly ever the case. When comparing a translated text with its original, even such seemingly unambiguous terms as definite articles are not in a consistent manner translated into the other language. The French arcicles, le, la, l', and les, for instance, are on the average only 64.6% at the time translated by the. In many instances, they are omitted altogether (14.2%), translated by the indefinite article (2.4%), or substituted by words other than articles.

Since translation is a two-way process and since a retro-translation seldomly reproduces the original statement from which the first translation originated these ambiguities are serious indeed. As already discussed in our section on interlingual communication systems, the ambiguity of the equivalence relations varies greatly between form classes. It is low for common nouns and verbs that denote perceivable actions; it is high for abstract terms and certain function words, especially prepositions.

Generally, most items generate an array of divergent equivalence terms, as much as an array of items may converge upon a common equivalence term. Subsequently, each cell on the main diagonals of the interlingual matrices which has been reserved for a single equivalence relation, needs to be substituted by a submatrix of equivalences. The realization of these complexities suggests two issues. First, equivalence relations are many-to-many relations. This problem might seem disturbing but can be appropriately handled with the methodology introduced in our second chapter and discussed in the remainder of the book. Indeed this issue is not any more complex than those of extralingual relations where, likewise, most single labels refer to a range of objects, events, or qualities. Second, since unique equivalence relations are the exception rather than the rule, translations should not be restricted to the word level, but have to intrude larger structural components. This conclusion introduces the concept of the rank of translation.

The rank refers to the structural level at which a translation occurs. Including transcriptions at the lower end, such as into different graphical styles or between phonemic and graphemic codes, the range of the rank extends into sentence translations. The further we move upward in rank, the less verbatim, the "freer" the translation becomes. Dependent upon the type of elements involved, translations will have to fluctuate in rank, sometimes producing one-to-one equivalence of unambiguous terms, sometimes using parts or whole sentences as units of equivalence.

The more a translation tends toward the latter condition, the more it becomes entangled in the semantic-syntactic organization of the sentence and the more it needs to rely on interlingual transformations. This is especially true when translating from a non-inflected into an inflected language. The latter using inflection as an additional clue for the identification of sentence parts can apply a more flexible word order than a language with a low degree of inflection. Stated differently, if sentence parts are sufficiently marked by inflections, inflected languages can use word order as a means for generating different types of sentences. Thus in German, statements, questions, and dependent clauses each are using a different obligatory order for the subject, predicate, and object of the sentences, whereas in English, the word order remains always the same. Subsequently, the language learner has to acquire specific interlingual transformation rules in order to translate or transfer information, a requirement which places a heavy burden upon his skills.

Cross-Linguistic Differences in Associative Behavior

In our analyses of cross-linguistic differences and bilingualism we had to determine, first, whether the principal method of our explorations, the restricted association tasks, could be adopted for the use in languages other than English and would be applicable without serious difficulties to students of foreign languages. For this purpose exploratory studies were conducted with native speakers of English, German, French, Spanish, Chinese, and Japanese. In a second series of studies, more detailed inquiries were made into the semantic-cognitive categories and general relations of English, German, Spanish and Italian. At the same time, differences in performance across three age levels were analyzed and methodologies for cross-linguistic, cross-sectional comparisons were explored.

Cross-linguistic differences in associative behavior between six languages: By using associative or similar techniques, performance might differ in the overall number of different responses produced by groups of Ss equal in size and elicited by sets of equivalent stimuli equal in number. Observed differences between groups could reflect variations in the size of the vocabularies either between languages or between groups of Ss or both. The former is of interest in the present section; the latter will be discussed in the next section and indicates variations in Ss' proficiencies. According to our diagram in Figure 1, variations in the size of the vocabularies would be represented by differences in the number of rows and columns of the corresponding relational matrix, i.e., by differences in the overall size of the matrices. Relational matrices of a given size may vary, furthermore, in the number of cell entries, i.e., in terms of how completely the matrices are filled. Again, there might be differences between the languages as well as between the language users, i.e., between proficiency levels.

The overall size of the vocabularies can be assessed by determining the number of different responses (Types) to one or several stimuli. When expressed as a ratio of the total number of responses (Tokens) this index is known as the Type-Token Ratio (TTR) and measures the repetition of responses to particular stimuli given by different Ss (subject overlap). A second measure determines the overlap of responses given by either single or several Ss to particular stimuli but under different task instructions (task overlap). At one extreme, all Ss might produce precisely the same responses to a particular stimulus under different task instructions. In this case, the classes of responses show the lowest degree of differentiation and Ss the highest degree of conceptual diffusion. At the other extreme, Ss might produce distinctly different sets of responses to the same stimulus under different task instructions. In this case, the differentiation of response classes and Ss conceptual clarity would be greatest.

In the following study we will make only crude estimates of the degree of conceptual clarity and response class differentiation, by enumerating average degrees of overlap between all the responses given by different groups of Ss to sets of equivalent stimuli under a fixed number of task instructions (for a more complete description see Riegel, 1968). In the next study, we will make finer differentiations in terms of the size and number of response classes, the number and types of general relations, and the dimensions of the semantic-cognitive space composed of such classes and general relations.

Twenty-four Ss each (12 males and 12 females with an age range from 18 to 34 years) were recruited within the following linguistic groups: English (American), German, French, Spanish, Japanese, and Chinese. Thus, 48 Ss each represented Germanic, Romance or Far Eastern languages respectively. All Ss lived in the United States but were native speakers of the above languages. Most of them (78%) were foreign graduate students in different departments at the University of Michigan, at Michigan State University or they were wives of graduate students. The others were undergraduate students, secretaries, research workers or junior staff members. The Americans were first- or second-year graduate students in psychology or in joint programs of psychology and other disciplines. Three of the German Ss came from Austria and one from Switzerland. The French group included five Belgians, two Algerians, and one S each from Morocco and Tunisia. Five of the Spanish speaking Ss came from South America; ten were from Venezuela, five from Argentina, three from Costa Rica and two each from Cuba, Mexico and Spain. All Japanese Ss were born in Japan. The Chinese came either from Taiwan or Hong Kong, but many of them were born on the Chinese mainland.

The paper and pencil tests were administered individually with self-explanatory instructions in the six languages and without time limits. The translations were prepared with the aid of various staff members in different language departments at the University of Michigan. Each test consisted of seven pages with 35 common noun stimuli selected from the Kent-Rosanoff word association test (1910). Two different orders of the stimuli were used in equal numbers for each language. Seven types of restricted association tasks (Coordinates, Similarities, Contrasts, Superordinates, Parts, Functions, and Qualities) were randomly assigned to seven pages of the test booklets. Furthermore, two test forms were used for all but English and Japanese. Each form was administered to 12 randomly selected Ss of the four remaining groups. The two forms differed in that they included one of two alternate translations of five English stimuli.

(1) The number of different responses is dependent upon the kind of relations tapped in the tasks. In some cases many appropriate responses, such as words denoting qualities, may be available in a language. The same result can be produced, however, when the number of appropriate responses, such as for contrasts, is small. In this case Ss may feel compelled to use less appropriate responses, a behavior which would yield many different responses, coupled with large numbers of blanks.

Insert Figure 3 about here

As shown in Figure 3 the average Type-Token Ratios for the Germanic languages are lowest (overall average: English = .41; German = .41) and those for the Romance languages are of intermediate magnitude (French = .50; Spanish = .52). The Type-Token Ratios for the two Far Easterr languages deviate from one another but, on the average, are higher than for the Germanic languages (Japanese = .46; Chinese = .60). Figure 3 also indicates the interactions between the seven tasks and the language families. The fluctuations in Type-Token Ratios between the tasks are roughly parallel between the Germanic and the Romance languages with Coordinates, Similars and Superordinates being farthest apart from one another. For the infralogical tasks of Parts, Functions and Qualities, the Type-Token Ratios of the Far Eastern languages are parallel to those of both the Romance and the Germanic languages, though consistently higher. With the exception of the Contrasts, the trend for the logical tasks parallels that of the Germanic languages, though is again higher. Thus, th task of finding opposites to common nouns, which proved especially difficult in the Germanic languages (highest number of blanks), seems to be relatively less ambiguous in the Far Eastern languages. Moreover, on Coordinates, Contrasts and Superordinates, the variability of the Far Eastern languages is lower than of the Romance languages. This result is further elaborated in the following analysis of task overlap.

(2) The overlaps between tasks was determined by counting for each S the number of identical responses given to the same stimulus under the seven instructions. However, instead of analyzing the seven-by-seven matrices thus obtained, we disregard the single overlaps between any two tasks and restrict our discussion to the sum of overlaps of any one task with the remaining six.

The average sums of overlaps are lowest for French (.69) and English (.91), and highest for Chinese (1.71) and Spanish (1.73). German (1.12) and Japanese (1.30) attain intermediate values. Since still higher sums have been observed for American undergraduates for the same set of tasks and stimuli (Riegel, Riegel, Smith & Quarterman, 1968), the variation between the six groups may be determined by differences in education as much as it is determined by differences between the languages. While this argument can be rejected only if the groups were perfectly matched in educational status(an objective which may be hard if not impossible to attain in cross-cultural studies), it becomes less valid if covariations rather than absolute amounts of overlaps and if language families rather than individual languages are compared.

Insert Figure 4 about here

As shown in Figure 4, Romance and Germanic languages have about equally high overlaps for Coordinates, Similars and Contrasts. Far Eastern languages, however, attain still higher values and thus reveal special conceptual difficulties in differentiating between these three tasks. In particular, an inspection of the complete overlap matrices shows unusually high correlations between Similars and Contrasts for Chinese and between Coordinates and Contrasts for Japanese. On the remaining four tasks of Superordinates, Parts, Functions and Qualities the overlaps of the Romance languages match those of the Far Eastern languages, whereas the scores for the Germanic languages are much lower.

(3) The main purpose of the present study was to test the applicability of tasks of association in different languages. Since most Ss were recruited on the campus of a university they may constitute groups comparable with one another on such variables as intelligence or educational status, but it is uncertain whether they represent equivalent samples of the populations in their native countries. The foreign groups are likely to be composed of Ss about as highly if not more highly selected than the group of American graduates. Since the measures applied have been found to vary with age and education (Riegel, Riegel, Smith & Quarterman, 1968) the present findings cannot be generalized readily to other sections of the populations.

Like the results of several previous studies of free-word associations (Levi, 1949; Lambert, 1956; Lambert & Moore, 1966; Rosenzweig, 1957, 1964; Kolers, 1963), the average response variability was lowest for American Ss. In contrast to the findings of Russell and Meseck (1959), however, the response variability in German was almost as low as in English. Low response variability is indicative of ease in test taking as well as of a high communality in school standards and a high degree of intracultural communication (Jenkins & Russell, 1960).

The agreement between the results on restricted associations and the previous ones on free associations was by no means a foregone conclusion. Mednick (1962) considers a flat distribution of free-associative responses as a sign of creativity. Free associative response variability also increases with age and education (Riegel & Riegel, 1964; Palermo & Jenkins, 1964; Riegel, 1968a), whereas the production of Superordinates, Similars, Parts, Functions, etc. converges, increasingly with age, toward a few appropriate items (Riegel, Riegel, Smith & Quarterman, 1968). The present results indicate that the negative relationship in response variability between free and restricted associations varies in magnitude from language to language and with the types of restrictions.

Similar results are obtained when the restricted associative overlaps were analyzed for the different languages. Even though the sum of overlaps of any one task with the remaining six correlates with the number of different responses, this correlation is far from perfect. For instance, French, which is but fourth in response variability, has the lowest response overlap, and thus, shows the greatest degree of response class differentiation and conceptual clarity. Chinese and Spanish have the highest response overlaps as well as the highest response variability.

Again, it would be premature to attribute these results exclusively to differences between the languages. Intelligence and age of Ss may be equally or even more important determinants. The present study has sufficiently shown, however, that restricted associations can be successfully adopted for use in foreign languages and that the results will indicate marked differences between individuals as well as between languages. The following study analyzes bilingual differences in a more specific manner.

Intralingual and Interlingual Differences in Bilingual Performance

In the following section we are discussing a series of investigations on the application of intralingual and interlingual relations. The first two studies are using American and Spanish students as Ss most of which are still engaged in acquiring second language proficiency. Only intralingual performances are tested but explorations are also made into types of bilingualism and levels of proficiencies. The last two studies are using American and German bilinguals both under intralingual and interlingual conditions. By obtaining reaction time measures of their verbal responses, explorations are made into processes intervening between stimulation and responding.

Intralingual associations of American and Spanish students: According to our interpretations, language acquisition consists in a gradual accumulation of relational information. Dependent upon the quality of the information given and the activity of the learner, words will be identified and their meanings progressively explicated; at the same time word classes and general relations will be abstracted from the relational information given.

With the few exceptions mentioned in the introductory sections of this chapter, second-language acquisition is delayed in comparison to that of the native language (this is, after all, the reason why we speak of second rather than alternate language learning). At the beginning, the few relations within the second language will be connected in multiple ways. If this were not the case (as it might occasionally happen under inefficient second language training procedures), relations would appear as isolated bits and, thus would neither allow for the explication of word meanings nor for the abstraction of word classes through the intersection of these relations.

At the beginning, the second language learner, thus, has available a few relations of a compact and overlapping set. Stated explicitly in reference to the present study, the following predictions are made: (1) When asked to react to a set of stimuli, a second language learner's response variability will be limited, his repertoire of responses is small. (2) When asked to respond differently under specific task instructions, he will repeat himself often by using identical answers under different instructions, thus, indicating a lack of differentiation of response classes.

(3) Generally, there will be differences in the approximation of the target language of native speakers. These three propositions were tested in the following study (for a more complete description see Riegel, Ramsey and Riegel, 1967).

> Forty-eight Ss participated in the experiment, 24 native English speakers and 24 native Spanish speakers. The first group consisted of undergraduates at the University of Michigan in a moderately advanced (5th semester level) Spanish course. The native Spanish speakers were, for the most part, graduate students or wives of graduate students at the University of Michigan. Partitioned according to dialect areas, ten were from Venezuela, five from Argentina, three from Costa Rica, and two each from Cuba, Mexico and Spain. All Ss were asked to rate their second language proficiency. By using the following four catetegories, poor (1), fair (2), good (3), and excellent (4), Spanish Ss evaluated their proficiency at 2.5 and American Ss at 2.2.
>
> All Ss took two tests, one in their native and the other in their second languages. At least three weeks elapsed between the two administrations. Each test consisted of seven pages of the same 35 noun stimuli used in the preceding studies. The following seven tasks were randomly assigned to the pages: Superordinates, Coordinates, Similars, Contrasts, Functions, Qualities and Parts. Two test forms were used in Spanish. Each form was administered to 12 randomly selected Ss. The two forms differed in that they each included alternate translations of five English stimuli.

(1) The design of the present study has been depicted in Figure 5. The shaded sections indicate the conditions tested and the degree of shading the proficiency differences expected. Turning first to the evaluation of the last hypothesis, i.e., on differences in the approximation of the target languages, the most direct measure of the success in learning a second language can be obtained by enumerating the identical responses given by the first and second language learners to a particular task and stimulus. In such a comparison three indices can be derived. The first is the most precise measure and includes, in the strictest sense, the number of identical responses given by both groups. This measure is called minimum group overlap, MGO. The second includes those responses given by both groups but based upon the frequencies of the native speakers. This measure is called first language group overlap, 1st GO. The third measure is the same as the second but lists the frequencies of the second language learners. This measure is called second language group overlap, 2nd GO.

Insert Figure 5 about here

The following simplified example will clarify the measures: If the word TABLE is given eight times by the first and five times by the second language learners as a Coordinate to the stimulus CHAIR, and if the response BED occurs three times among the first and four times among the second language learners, then the minimum group overlap, MGO (always using the lowest of the two figures) equals 5 + 3; the first language group overlap, 1st GO, equals 8 + 3; and the second language group overlap, 2nd GO, equals 5 + 4.

Insert Figure 6 about here

The three measures are also explained in the Venn diagram of Figure 6 which elaborates the concept of "shared sign systems" discussed in the introduction to this chapter. The two large circles represent the responses of the first and the second language learners, respectively. The intersection, the double shaded area, represents the minimum group overlap (MGO). The left shaded area (including the intersection) represents the first language group overlap (1st GO), and the right shaded area the second language overlap (2nd GO). Overlapping responses in each group that are <u>not</u> accounted for by the minimum overlap (shaded half-moons) can be derived by subtractions. In particular, (1st GO) - (MGO) = A, the overlapping responses by the first language learners not accounted for by the minimum group overlap, i.e., responses to be incorporated at higher frequencies into the repertoire of the second language learners for a good approximation of the target language. The overlapping responses by the second language learners not accounted for by the minimum group overlap are given by (2nd GO) - (MGO) = C, and represent "over approximations", i.e., responses which are used by second language learners more frequently than by the native speakers. The frequencies should be reduced for a good approximation of the target language. Finally, area B represents those responses that are not yet used by the second language learners at all, and D those that are only used by the second language learners. Both B and D (unshaded half-moons) can be derived by subtracting MGO and A (or C) from 100 percent. The percentage of B should be increased and that of D should be reduced to zero for a perfect approximation of the target language, i.e., the two circles should move toward one another and merge in the end.

Congruent with their self-evaluations, second learners of Spanish are less proficient than those of English. The average minimum group overlap with the native speakers, MGO, is only 28.5% for students of Spanish, but 44.4% for students of English. Moreover, the percentages of words that occur already, but not as frequently as for the native speakers, A, are only 10.1% for the second learners of Spanish, but 22.2% for the second learners of English. This brings the total percentages of words that are already in the repertoire of the second language learners and are also used as responses by the native speakers to 38.6% for the Spanish and to 66.6% for the English language. Complementary, second learners of Spanish have to acquire 61.4% new items (B) but those of English only 33.4%.

In our interpretations we, certainly, do not maintain that a proper frequency approximation is all that is needed in second language learning. Insights into qualitative differences in distributional properties of the two languages have to be obtained through comparisons between the different tasks. Eventually, this information might provide specific information to the teacher as well as to the students on the latter's deficiencies and strengths in his second language studies.

As shown in Table 1, rather marked differences exist between the tasks. The second learners of Spanish deviate most strongly from the native speakers on the response classes of Similars and Qualities. Both the minimum group overlaps, MGO, and the percentages of responses already acquired but used too rarely, A, are low and thus, the percentages of responses not yet acquired, B, are above 70%. In comparison, MGO for Parts is also low, but since the response class A is relatively large, learning has progressed much further than for Similars and Qualities and the percentage of responses not yet acquired is but 58.8%. Most progress has been made on the class of Contrasts where only 47.2% of new responses have to be acquired and where the minimum overlap, MGO, is already very high (42.6%).

Insert Table 1 about here

The second learners of English are most delayed in their acquisition of Quality responses but have progressed well on Similars for which, in particular, the percentage of the minimum group overlap, MGO, is relatively high (44.6%). They are farthest advanced in the class of Coordinates and Contrast which are closely followed by Similars. In these three tasks only about 28% of the responses of the native speakers are not yet part of the repertoire of the second language learners.

(2) The number of different words used in samples of free speech or writing of a standard length is indicative of Ss' mastering of the language as well as of possible differences between languages. As indicated in our first hypothesis, we would,therefore, expect native speakers to excel second language learners. However, it is also well known (see Lambert & Moore, 1966; Levi, 1949; Riegel, 1968b; Rosenzweig, 1961, 1964; Russell & Meseck, 1959) that, generally, native speakers of English produce fewer different responses in word association tests than native speakers of any other language investigated. In the present study, these results were further confounded with differences in second language proficiencies between the groups of Ss.

Even though native speakers of English produced fewer different English responses in all seven tasks (average = 9.2 out of a total 24 responses) than native speakers of Spanish in Spanish (average = 12.2), both groups seemed to transfer their native response tendencies to their second languages. Thus, the American Ss produced fewer different responses in Spanish (average

= 8.7) than Spanish Ss in English (average = 10.5). However, both groups produced fewer different responses in their second than in their first languages (American Ss drop from 9.2 to 8.7; Spanish Ss from 12.2 to 10.5), and thus, confirmed our prediction of the smaller vocabulary size and response variability of second language learners.

> When comparisons were made between the seven types of relations, the two groups of Ss differed significantly on all tasks except Parts and also the group by language interaction effects were significant in these cases. The differences between the languages were significant for the Coordinates only. Under all four conditions, Ss produced the smallest number of different responses on Contrasts (average = 13.9).

(3) If, in line with our relational interpretation, we place the stimuli at the left margin of a matrix, such as shown in Figures 7 and 10, then the responses would appear on top of the columns at the upper margin. The occurrence of any particular stimulus response relation could, then, be check-marked in the corresponding cell of the matrix. If many Ss were giving the same response to a stimulus, it would be convenient to indicate its frequency of occurrence in the corresponding cell. The reduction in response variability, due to the repetition of the same responses by different Ss has been analyzed in the preceding section.

If Ss select responses to certain stimuli according to different instruction, their responses might also overlap. The ability to produce distinctly different sets of responses to the same stimuli but under different instructions is indicative of their categorizational skills and their language proficiency. While focusing on this issue, we should also realize that their success depends, at the same time, on the structure of the language within which they are working. Languages vary in the extent to which they differentiate particular classes of words and general relations that define these classes. At the present time, we do not know much and will disregard the little that we know about differences between languages in categorical and relational systems.

The response repetitions are enumerated by counting the number of identical responses given to the same stimulus under the seven instructions. This provides us with one half of a seven-by-seven summary matrix. In the present analysis we will disregard the single overlaps between any two tasks, however, and restrict our analysis to the sum of overlaps of any one task with the remaining six. Tables 2 present the sums of overlaps per S and stimulus multiplied by 100.

Insert Table 2 about here

As can be derived from Table 2, the sums of overlap added over tasks are on the average higher, i.e., the conceptual differentiation is lower, for the English than for the Spanish language (228.4 vs. 184.2), for second than for first language learners (234.2 vs. 178.5), and for Spanish than for American Ss (223.2 vs. 189.4). In making more specific comparisons, native speakers of English show a greater overlap than native speakers of Spanish on tasks of logical relations namely on the tasks of Coordinates, Contrasts and Similars with the exception of Superordinates. On the remaining tasks, the infralogical relations of Qualities, Functions, and Parts (denoting physical conditions of the objects or events named by the stimuli), native speakers of English have lower overlaps and, thus, show greater conceptual clarity than native speakers of Spanish.

The overlap distributions across tasks parallel for both groups of second language learners those of the native speakers. However, the sums of overlaps are higher for the second language learners than for the native speakers, indicating lower conceptual clarity. This result holds in particular, for the second learners of English and should be compared with their wider response variabilities noted before. Apparently, the many different responses produced by the second language learners of English are repeatedly used under different instructions.

Comparisons between the first and second language learners within each language, reveal close approximations of the target languages by the second learners of Spanish. The second learners of English, however, seem to "over-approximate" their target language by producing much higher overlap coefficients and thus, a less satisfactory conceptual match. Again, these results ought to be compared with those on the response variabilities, where the students of English, but not those of Spanish, approximate quite closely their target language. Apparently, the former (Spanish Ss) have acquired a richer vocabulary in English than the latter (American Ss) in Spanish, but fail to approximate as well the conceptual verbal structure of their target language. This result may be partially explained by the great amount of formal training received by the second learners of Spanish (American Ss). The second learners of English (Spanish Ss) represent a more heterogeneous group and their strength lies in their ability to converse in English. Many of them acquired their English language skills during active communications with Americans in this country without, or with little formal training in their second language.

(4) The present investigation has been based on the assumption that second language learning should not only result in approximations of the number and types of responses which native speakers use but also in an assimilation of the conceptual structure of the target language representing its semantic classes and class relations. In this regard native speakers of English were found to display less clear conceptual distinctions between Coordinates, Contrasts, and Similars than native speakers of Spanish. They separate more clearly, however, responses denoting Parts, Qualities, or Functions.

As anticipated, the conceptual structures of second language learners are less clear than those of native speakers. Surprisingly, the retardation was more marked for the English of the Spanish Ss who on all simpler measures scored above the American Ss studying Spanish. Generally, the American students were very sensitive in reducing or increasing their response overlaps in approximating the Spanish target language. Spanish students, however, increased indiscriminately the overlaps on all tasks and thus, while superior in fluency with which they produced many different responses, were inferior in approximating the conceptual structure of the English target language. If we compare these results with those obtained on precisely the same tasks from Ss differing in educational levels and age (Riegel, Riegel, Smith & Quarterman, 1968), we find that in their differentiation of response classes, the Spanish of the American Ss resembles closely the English of American college students, whereas the English of the Spanish Ss corresponds more closely to that of American 6th graders.

Our findings of the differentiation of classes are at variance with those on the simpler measures of language proficiency. The group overlaps, for instance, show much higher values for English than for Spanish. The students of English (Spanish Ss) have incorporated on some tasks as many as 72% of the words used by the native speakers, whereas the highest figure for the students of Spanish (American Ss) equals only 53%. However, the discrepancy between these results is easily understandable. It is not sufficient to evaluate the progress in second language learning by enumerating the number and variation of vocabulary items; the apprehension and utilization of the conceptual structure of the target language have to be tested. Our Spanish students of English were inferior in the latter but superior in the former. Since they had less formal second language training than the Americans, but had primarily acquired their English during active, daily communication in an American environment, our findings also suggest differences in the effects of training and teaching procedures. Formal language training in college settings encourages the identification of the conceptual structure of the target language, whereas the informal training in everyday communications leads to fast increases in vocabulary and verbal fluency.

Implicit response tendencies in intralingual and interlingual associations: In our first study, distributions of intralingual restricted associations were analyzed for native speakers and second language learners of English and Spanish. In the following study both intralingual and interlingual free and restricted word associations are obtained from native speakers of English with second language training in German. Major attention will be given in this analysis to intervening response tendencies for explaining performance differences.

In particular, the predictions of the present study are derived from the notion that response variability and types (as well as response speed) are determined, on the one hand, by the number of items available in the active vocabulary. If this number is small, as for second language learners, also the number of different responses will be small. On the other hand, response variability and types are also determined by specific response preferences or sets. If, for instance, second language learners prefer translation responses under interlingual conditions their response variability will be further reduced. Both these general propositions interact under various conditions. Whenever the first prevails, a specific hypothesis can be derived; when the second prevails an alternative hypothesis is available. In the present study the following four hypotheses and their alternatives will be tested.

First, since the second language vocabulary of our Ss is smaller than their first language vocabulary also the set of intralingual relations will be smaller (Hyp. 1a). Alternatively we predict that since specific response preferences or sets are not as firmly established in the second language, words might be connected in a greater number of different ways (Hyp. 1b).

Second, because of the differences in the size of the vocabularies, the sets of interlingual relations will fall between the sets of intralingual relations of the first and of the second language (Hyp. 2a). Alternatively we predict that under interlingual conditions second language learners might choose specific response sets (Hyp. 2b). For instance, they might (i) select responses formally similar with their stimuli (e.g., have identical initials), (ii) search for translations, or (iii) search for substitutes of the stimuli (i.e., produce paradigmatic responses). These tendencies will reduce the response variability under interlingual conditions. Under intralingual conditions, responses will be scattered more randomly. If they can be categorized at all, they are likely to be of sequential, syntagmatic types.

Third, if we impose additional constraints upon S's performance by asking him to respond within specific categories, the variability for both the first and the second language will decrease (Hyp. 3a). Alternatively we predict that since stimulus-response relations are insufficiently established in the second language (except for translative and similar tendencies under interlingual conditions), this effect might be reversed (Hyp. 3b). Subsequently, we expect for all but the intralingual condition in the native language (i) greater response variability for restricted than for free associations, (ii) greater response overlap, i.e., less differentiation of the response classes obtained under different types of restrictions, and (iii) greater similarity between restricted and free associative responses.

Fourth, since a person's active vocabulary is smaller than his passive vocabulary, response variability is more likely to be affected in comparisons between response than the stimulus languages. Because of the lower proficiency, this effect will be strongest if the second language is the response language. It will be of intermediate magnitude for the interlingual conditions and weakest if the native language is the response language (Hyp. 4a). For the alternative hypothesis we would have to assume that a person's active vocabulary is larger than his passive vocabulary and, subsequently, that the order in which the conditions are affected would be reversed (Hyp. 4b). Such an assumption does not seem very reasonable, however, since it merely implies a negation of the fourth hypothesis as originally stated.

Ten male and 14 female undergraduates participated in the experiment. Ss had between one and five years of formal training in German at the high school or college level. Sixteen of the Ss had between one and 13 months of experience in a German speaking country.

When Ss signed up for the experiment, two verbal fluency tests were administered in a counterbalanced order. Ss were asked to write down as many English (or German) words as they could think of during a 3-min. period. The verbal fluency tests (which do not represent a central part of the experiment) provide estimates of Ss active vocabularies. On the average, Ss listed 66 English and 31 German words per 3-min. interval. Since there was no overlap in the distributions of the numbers of words between the two languages, this difference is highly significant and supports the assumptions implied in the first two hypotheses.

The word association tests were administered individually with self-explanatory instructions. A test consists of five free and four sets of eight restricted association tasks. Free associations were always given between two and four days prior to the restricted associations because performance on the latter may influence that on the former while the reverse is not likely. The four sets of restricted associations were split into two halves and administered between two and four days apart from one another.

The 40 pairs of noun-equivalents were taken from the Michigan norms (Riegel, 1965a,b; Riegel & Zivian, 1968) and were used as stimuli for both the free and the restricted association tasks. The stimuli were presented in two serial orders. The orders were randomly selected for each task. However, both orders were used an equal number of times for each type of restricted and for the free association tasks as well as for each of the testing conditions.

Free associations were obtained from each S under five conditions of which EE, GG, EG, and GE were administered in counterbalanced order. For the purpose of comparing responses given to (presumably) unknown stimuli with those given to stimuli with which Ss were partially (German stimuli) or fully familiar (English stimuli), free associations were also obtained in English to equivalent French stimuli (FE). It turned out, however, that 12 Ss had some knowledge of French. In order to avoid distortions of the main body of the data, FE was always given as the last of the free association tasks.

Each S responded under all four conditions (EE, GG, EG, and GE) to the eight restricted associations task. The order of the conditions was counterbalanced and the order of the following eight types of restrictions was randomized for each condition and for each S: Superordinates, Similars, Function, (Verbs), Qualities (Adjectives), Foregoing Words, Following Words, Locations, Parts.

(1) In spite of Ss' smaller vocabulary (as estimated by the verbal fluency tests), the average intralingual response variability (TTR) is larger for German (GG) than for English (EE) (see Table 3). Thus, the few items available in the second language area connected in a greater number of different ways than in the first language for which particular response preferences seem to have been well established (Hyp. 1b). The TTRs do not differ between the two interlingual conditions (GE and EG) but are markedly lower than for both intralingual conditions (GG and EE) (Hyp. 2b). An analysis of variance indicates significant effects of the response language and the interaction (interlingual vs. intralingual comparison) but not of the stimulus language (Hyp. 4a).

Insert Table 3 about here

In exploring the particular response preferences or sets that produced the low variability under interlingual conditions, three methods were applied:

(i) We enumerated the percentages of responses with initials identical with those of their stimuli (PSI). These percentages are lowest for the condition most familar to Ss, namely for EE (7%). (This result was replicated when the responses to the same 40 stimuli obtained from the 100 Ss of the Michigan norms were analyzed; in this case PSI equals 9%). The percentages are much higher for all the others and, in particular, for the interlingual conditions. When only those Ss are considered who did not indicate any knowledge of French (n), 58% of the responses for FE can be accounted for on this basis alone. Ss with some knowledge of French produce about as many responses of this kind as Ss under the GE condition.

(ii) As the comparisons of these percentages (PSI) between FE and the four other conditions show, the strategy of producing responses identical with the stimuli in their initials becomes less important with increasing language proficiency. Ss sufficiently acquainted with both languages seem to shift to highly organized and selective, namely to translation responses. As a test of this proposition and applying the most stringent criterion of of equivalence, we enumerated the percentages with which our own translations of the stimuli were emitted as responses by Ss (PTS). Even though these percentages may be somewhat inflated since Ss had to go repeatedly, i.e., four times, through the lists of equivalent stimuli and thus, may have learned to equate the translations with one another, they are high enough to warrant unambiguous interpretations.

The percentages of responses that are translations of their stimuli (PTS) decreases with stimulus frequencies. The 14 most common words produce 60% translations in the EG conditions, the 13 medium frequency words produce 55%, and the 13 low frequency words produce 47%. Similarly, there is a decline with word frequency of the stimuli in the percentages of responses with initials identical with those of their stimuli (PSI) from 60% to 55% and 44%. All these percentages decline somewhat less regularly for the GE and FE conditions, most likely because the application of the American word count (Thorndike & Lorge, 1944) is less appropriate for the German and French stimulus-equivalents.

Even though translation seems to be the primary mode of responding under the interlingual conditions, it would be false to regard responding by partial identity of stimulus and response (PSI) as a secondary strategy and, possible, to consider the two percentages as additive. Rather both strategies are interrelated. Among our own translations, the percentages of identical stimulus and response initials (PSI) equals 30% for the English-German, 32% for the English-French, and 18% for the German-French equivalents.

(iii) According to our present results, Ss are not "really free" when responding in a free association task. Similar arguments have been made in a report by Livant (1967) on the free associations of Polish and American Ss. Under the interlingual conditions in particular, Ss tend either to translate the stimuli or utilize superficial similarities to aid their performance. The restricted association tasks allow for the analysis of further response preferences or sets which direct Ss' free associative behavior. For this purpose we compared the eight types of restricted associations of the interlingual conditions of GG and EE with the five conditions of free associations. In particular, we enumerated the same of those free associative responses which were identical with the restricted responses given to the same stimuli by our 24 Ss.

In comparing the response languages, more of the German free associations (EG and GG) were accounted for by German restricted associative responses (GG) than were the English free associations (GE and EE) by the English restricted associative responses (EE). The difference averaged over the eight types of relations was significant and equalled 4%. In comparing the stimulus languages, the restricted associations accounted for larger percentages of free associations elicited by English than by German stimuli, but these differences were not significant. By far the largest and significant differences were observed for the intralingual and interlingual conditions. The average increase amounted to 9%.

Insert Figure 7 about here

As shown in Figure 7, the largest number of intralingual free associations are accounted for by the syntagmatic responses of Following Words (36%) and Foregoing Words (30%). Third in rank are Similars (29%). For the interlingual conditions, however, Similars and Superordinates account for more free associative responses (19% and 18% respectively) than either Following or Foregoing Words (11% each). Thus, under interlingual conditions Ss exhibit stronger tendencies to search for substitutes of the stimuli, i.e., for paradigmatic responses (of which Similars and Superordinates are special cases), rather than to rely on responses that reflect their experience with linguistic sequences, i.e., syntagmatic responses of Foregoing and Following Words. Since translations are a special form of stimulus substitution this result supplements our previous observation of high translative tendencies under interlingual conditions.

When the number of translations are added to the number of free associations accounted for by the restricted associations, the total number of free associations given under EG which can be accounted for in either way equals 1591 and approaches closely the number of responses accounted for under GG (1615). For both GE (1102) and FE (609), however, the figures remain far below that obtained for EE (1963). Thus, for GE and FE relatively large number of free associative responses are neither translations of the stimuli nor can they be accounted for by the restricted associations, but are random variations not determined by any detectable response preferences or sets. As noted before, many are selected on the basis of superficial similarities, such as their initials.

Insert Table 4 about here

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(2) Our analysis of response preferences and sets in free associations could provide misleading interpretations if we were to regard all restricted associations as independent. For an analysis of their correlation we enumerated the overlap between the different restrictions separately for each S. The overlapping (identical) responses given under any two of the eight restrictions added over stimuli and Ss thus can be obtained. However, for more comprehensive comparisons, we derived the sums of overlaps of each single task with the other seven. Generally, these comparisons reveal that under all four conditions Parts, Locations, Similars and Functions are most clearly separated from the other tasks. Following and Foregoing Words are conceptually least distinct. When conditions are pooled by response languages,

German responses are always more overlapping than English responses (Hyp. 4a). When the conditions are pooled by stimulus languages, no significant differences are found. With the exception of Superordinates and Similars, this holds also for the comparison of intralingual and interlingual conditions.

As a comparison of Tables 3 and 4 shows, the number of different responses (TTR) for restricted associations vary less markedly among the four conditions than those for free associations. When comparisons are made within the interlingual conditions of EG and GE, Ss react always more "freely" on the tasks of restricted than of free associations, i.e., the number of different restricted associations is always higher (.41 to .76 for EG; .42 to .73 for GE) than the number of different free associations (.32 for both EG and GE) (Hyp. 3b). This result can be explained by Ss' translative tendencies in free associations which reduces the variability. For intralingual conditions of EE and GG, Foregoing and Following Words elicit greater numbers of different responses (.72 and .69 for EE; .76 and .70 for GG) than free associations (.55 for EE; .63 for GG) (Hyp. 3b). Thus, Ss often react more "freely" under restricted than under free associative instructions and it is questionable whether the latter provide "the most nearly context-free of all the techniques of eliciting verbal responses to particular stimuli [Deese, 1965, p. 42]."

(3) Specific hypotheses about the psycholinguistic behavior of second language learners have been derived from two general propositions. First, response variability will be determined by the responses available in a repertoire. Second, response variability will be determined by response preferences and sets. According to our results, the second factor is the more important determinant of Ss' bilingual behavior. Thus, when the number of different free associative responses were compared between the intralingual conditions, the response variability was greater for German than for English even though the differences in vocabulary point in the opposite direction. Presumably, response preferences and sets are insufficiently established for the German language of our Ss. However, response variability is markedly lower for both interlingual than for both intralingual conditions. Presumably, Ss apply systematically either superficial clues (producing responses which have the same initials as the stimuli), translate, or search for substitutes of the stimuli (paradigmatic responses). Again, the differences in the vocabulary between the first and second languages would have led to the wrong prediction, namely that response variability under interlingual conditions ought to fall between those of the intralingual conditions of the first and the second language.

When comparing the number of different responses of the restricted and the free association tasks, we should expect lower response variability for the former. Our results indicated, however, that particular response classes and stimulus-response relations do not seem to have been sufficiently established in the second language of our Ss. The number of different responses for the interlingual conditions is always higher for the restricted than for the free associations. Under the intralingual conditions, two tasks of restricted associations (Foregoing Words and Following Words) produce larger response variabilities than free associations. These results raise the general question of how "free" Ss are when responding in a free association test and with what kind of response preferences and sets they arrive in the laboratory. Even though the results shown in Figure 12 provide some specific answers, this problem has not been pursued much further in the present section but has been discussed in chapter XII.

A successful application of the dualistic notion of response availability and response preferences and sets is not limited to the study of bilingual behavior. As discussed in chapter IX, psycholinguistic performance of creative persons has been characterized by increased response variability in conjunction with well developed response preferences that allow for appropriate and efficient selections (Riegel, Riegel & Levine, 1966). Psycholinguistic performance of schizophrenics can be characterized by the concepts of overreaction and counterreaction: whenever the external constraint is weak, as under free associations, schizophrenics impose their own severe response restrictions; whenever the external constraint is strong, as under certain restricted associations, they react very "freely" (Stern & Riegel, 1970). First language acquisition consists in an increase in response variability and in the development of specific response classes, both in regard to language production (Riegel, Riegel, Quarterman & Smith, 1968) and language comprehension (Quarterman & Riegel, 1968; Zivian & Riegel, 1969). Aging leads toward further strengthening of response classes and by a strong temporary, but not persistent, preference for any kind of logical relations at the expense of the more common infralogical and grammatical relations (Riegel & Riegel, 1964).

The mechanisms of response preferences and sets, as applied in several of our investigations are not vague, mentalistic constructs but have an operational basis in the semantic-syntactic structure of the languages as well as in the physical order of the environment with which individuals are confronted. If linguists and psychologists succeed in describing these structures in a comprehensive and systematic manner, it will become possible to analyze response preferences and sets "objectively" and to develop a firmer basis for the study of individual and developmental differences. Bilingual behavior, in this respect, does not only repre[illegible] specific dimension of variation but also enables us to study interac[illegible]n of different linguistic structures, and perhaps, of some invariant features of psycholinguistic organization. A comprehensive analysis of these problems suggests new approaches to second language learning and teaching.

The Speech of Interlingual Transformations in English and German

Languages differ in their degree of inflection, i.e., in the variation of word forms marking case, number, gender, person, tense, etc. Because the function of the word within the sentence is marked by its form and not by its position in the sentence alone, the greater the degree of inflection, the more flexible the word order in sentences can be. For example, the highly inflected Latin language allows every word order, whereas English with little inflection imposes a rigid word order. Even simple English sentences of the form subject-predicate-object (S-P-O), follow the rule of order very strictly. German, on the other hand, which is a more inflected language than English allows (if judged with some linguistic tolerance) all of the six permutations of S, P, and O. These variations in word order and their effect upon translation speed are the topic of the present study.

The most common, declarative form is the same in German as in English (S-P-O), e.g., "Der Vater wäscht den Jungen" and "The father washes the boy." Two permutations in German are applied to mark certain sentence forms. The form P-S-O indicates a question, e.g., "Wäscht der Vater den Jungen?", whereas in English, the auxiliary "do" is used to mark the question, but no change in word order occurs, i.e., "Does the father wash the boy?" The German dependent clause requires the word order S-O-P, e.g., ..."weil der Vater den Jungen wäscht," whereas the English dependent clause leaves the sentence unchanged, e.g., "..., because the father washes the boy". The German passive sentence, finally rearranges the sentence parts more thoroughly by splitting the verb, e.g., "Der Junge wird von dem Vater gewaschen", than the English passive sentence, e.g., "The boy is washed by the father".

The remaining permutations are less common and non-obligatory in German but, with some linguistic tolerance, are acceptable for shifting emphasis. For example, in the following P-O-S question and in the O-P-S and O-S-P statements the emphasis is always on the boy; "Wäscht den Jungen der Vater?", "Den Jungen wäscht der Vater," "Den Jungen der Vater wäscht". Admittedly, all these expressions appear unusually but, due to the inflections, their meaning can be unambiguously identified. (This does not hold for the same sentences when either or both the subject and the object are of female or neuter gender; in these instances, there are no inflectional differences between the nominative and accusative cases of the nouns which would make the identification of the subject and object of the sentence possible. For example, the P-O-S question, "Wäscht das Kind die mutter?", is likely to be interpreted as if the child were washing the mother.)

All our examples have shown that translations between inflected and non-inflected languages require changes of word order. But there are also additions and deletions. For instance, the English language uses the addition of "do" to mark the question. These markings are, especially used by languages which do not have much freedom in the choice of word orders. These considerations lead to the hypothesis that intralingual transformations in English are easier to perform than intralingual transformations in German. Two related arguments support this prediction. Fewer rearrangements of words are necessary in English and therefore there is less load upon the performing S. There is a higher certainty about the outcome in English because according to the strict word order rules there is very little choice.

Transformation ules are an important part of Chomsky's generative grammar. As additions, deletions, changes in order and other formal operations they are applied to some basic linguistic structures, which themselves might adequately be explained in terms of phrase structure rules. Since we are interested in bilingual behavior, we expand the notion of transformation to interlingual conditions. Limiting our arguments to the example of the question, we have already shown that the English question is generated by adding an auxiliary, whereas in German the question is formulated by reversal in word order. Therefore, the translation of an English question into German can be understood as a structural transformation. Since German sentences are more variable in word order and since the shift from a more variable to a less variable condition is easier than in the opposite direction, we conclude that it is easier to translate a sentence from German into English than from English into German. Supplementing this hypotheses by the prediction that intralingual transformations are easier than interlingual transformations we can summarize them as follows, whereby the first letters of pairs indicate the stimulus language and the second the target language.

H 1: Intralingual transformations are easier in English (EE) than in German (GG).

H 2: Interlingual transformations are easier into English (GE) than into German (EG).

H 3: Interlingual transformations (EE, GG) are easier than interlingual transformations (GE, EG).

Substituting the first two hypotheses into the third one we derive the following order of difficulty for the four language conditions to be tested:

$$EE < GG < GE < EG.$$

Finally, we predict that,

H 4: All transformation difficulties are more marked for second language learners of German, who have no familiarity with variable word orders from their native language than for native speakers.

In the following experiment, three sentence forms in both English and German are used, i.e., active declaratives, questions and passive forms. Both a group of native speakers of English and of German were tested and Ss were required to transform both within their first and their second languages as well as between both languages in both directions. The transformational difficulty was measured by speed of translation.

The experiment was conducted in the United States (Ann Arbor) with native speakers of English and in Switzerland (Zürich) with native speakers of German. In both cases Ss were University students, who studied the second language as their main area of concentration and who were recruited on a voluntary basis. The 20 Swiss Ss included 11 males and 9 females, with a mean age of 26.3 years. All of them had a good knowledge of English, having studied it in Gymnasium for at least three years. During the experiment four Ss had to be replaced because of their high error rates.

The three transformations in both languages made up a total of six different sentence types to be tested: the English declarative form (ED), the English question (EQ), the English passive form (EP), the German declarative form (GD), the German question (GQ), and the German passive form (GP). A set of 12 sentences was chosen, each of which was composed of six words in the active declarative form and each of which was of the form subject-predicate-object, e.g., "The father has eaten the bread" or "Der Vater hat das Broat gegessen." The present perfect tense was chosen to make conditions as comparable as possible, e.g., to keep the number of words equal in both languages.

The 12 sentences were randomly divided into two groups each including all of the six sentence types. Each sentence was written on a single sheet. These sentences will be called input sentences (I). Two measures of the same transformation of the same sentence type were taken to counteract possible influences of the content of the particular sentences. The 12 sentences, in randomized order, made up one test booklet. All sentences of one test booklet had to be transformed into one specific sentence type according to the instructions preceding the test booklet. These sentences will be called output sentences (O). Each transformation produced (O) was written down below the given sentence (I).

The task was as follows: S read a given sentence, wrote the required transformed sentence as quickly as he could, pressed a button, turned the page and went on with the next sentence. In this way S completed six test booklets in randomized order, one booklet for each of the six sentence types to be tested.

Also the six output sentence types were randomized. A few minutes rest were given between test booklets.

Before the six test booklets were administered, a general instruction was read to S explaining the task and three practice booklets were given, one for each of the input sentence types to be transformed. Speed of performance was emphasized. Furthermore, the complete vocabulary list was presented to Ss for a short study and for further reference during the task. This list contained all the English and German words of the sentences of the experiment. The list was used to eliminate unfamiliarity with the vocabulary.

The transformation time was measured from one button press to the next. At the beginning of each booklet a dummy sentence was presented, the transformation time of which was not recorded but which elicited the first utilized button press for a booklet. The button press alternately activated two clocks by means of a relay flip-flop. This gave E enough time to record the time and to reset the clock. In Switzerland, however, no electrically operated clocks were available. Therefore, mechanically operated stop watches had to be used. By pressing a bar which connected three watches, they were alternately started, stopped and reset. To hold the conditions as comparable as possible, there was a button for S to press, and his button press was immediately duplicated by E pressing the bar. Still, there remains a difference in timing caused by the delay of the E's pressing. For comparison of the American and the Swiss data, special adjustments of the data are necessary therefore which shorten the Swiss latency measures by correcting for the delay of E's reaction.

Without going into the technical details of the results, in interlingual and intralingual transformation tasks, transformations into German take more time than those into English. Intralingual transformations are faster than interlingual ones. All results shown in Tables 5 and 6 seem to support that the hypothesized order of increasing transformation difficulty, EE < GE < GG < EG, is more marked for native speakers of English than German. However, a simpler explanation for transformation time than transformation difficulty has to be considered first.

Insert Tables 5 and 6 about here

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(1) Writing time: According to the analyses of variances, the main load upon the performing Ss lies in the production of the response sentences. Due to the procedures used, translation times represent confounded measures of understanding, transforming and writing. If writing takes more time

than understanding and transforming than the total translation time should be correlated with the amount of writing to be done. A Spearman rank correlation (with correction for ties) between the number of letters to write and the translation times for output sentence types equals 0.79 ($p < .05$) for native speakers of English and .0.97 ($p < .01$) for native speakers of German. Thus, the translation time of German speaking Ss can be reduced to a certain extent, to the time it takes to write the sentences. For English speaking Ss this is less true.

The relationships are graphically represented in Figure 8. Here, the total number of letters in each sentence type is plotted against the total translation time for each output sentence type. A nearly linear function is found for the German data, whereas the English data are pulled apart into two subsets representing the English and German output sentences, respectively. The English data can be described neither as linear nor as monotonous.

Insert Figure 8 about here

The difficulties with the output sentences of native speakers of English can be explained less well by writing time. As the analysis of variance has shown, the difficulty to render any sentence into German is rather great for them; All the findings are more significant for the native speakers of German. Therefore, our summarized hypotheses is still valid for the native speakers of English; for them the order EE < GE < GG < EG represents appropriately the increase in difficulty. However, their difficulties cannot be explained in a unique way. Since the German output sentences (which prove to be rather hard for them) imply writing, and since the interlingual transformations (which also prove to be hard for them) do not provide a possibility to copy the word forms as the intralingual transformations do, the measured difficulty could reflect their unfamiliarity with German orthography. Another reason for the problems of native English speakers in German may consist in their overall lower proficiency level. Finally, the unfamiliarity with the tested grammatical structures could cause the difficulties. All these explanations relate the difficulty of English speaking Ss with German to their relative unfamiliarity with properties of this language. If no basic difficulty of the German language is assumed (since the data suggest no differences in difficulty between the English and the German language), the difficulties of the English speaking Ss with German may be overcome through considerable additional experience.

(2) Number of transformations. As pointed out before, the intralingual conditions are easier than the interlingual ones (this is true for English speaking Ss and somewhat less strongly for German speaking Ss). In other words, transformations are easier to perform if no translation is involved. As suggested in the introduction, translations can be understood as structural changes similar to transformations. They too imply

rearrangements as well as other operations similar to transformations. Adopting an additive model of transformations (Mehler, 1963; Savin & Perchenock, 1965), which assumes higher difficulty of sentences involving more than one transformation, the latencies in the present experiment might be assumed to be related to the number of "transformations" they require, i.e., either no transformation and no translation (0 transformation) or only one transformation or translation (1 transformation), or both one transformation and one translation (2 transformations). The Spearman rank correlation coefficients (with correction for ties) between such an index and translation latencies fail to show, however, the value of such an explanation for our data (English: $r_s = .25$, $p > .05$; German: $r_s = .25$, $p > .05$).

(3) Number of changed positions of words: As another explanation of the varying degree of difficulty of the tested transformations we postulate that the performance time is a function of the number of words or sentence components that have to be added or altered in their funtions. Sentences with more serial changes put a greater load up on the memory of the translator. Thus, in the first version of this analysis the number of changed word positions was enumerated by considering every word as one position and any newly inserted word as a change of one position. Table 7 shows the numbers for all the transformations executed summed over six sentences. The Spearman rank correlation (with correction for ties) between number of changed word position and performance times is $r_s = .32$ ($p < .05$) for the English data and $r_s = .48$ ($p < .01$) for the German data. Thus, the number of words to rearrange in order to perform a transformation has some influence upon the performance, especially for native speakers of German.

This finding is somewhat in contradiction to the earlier suggestion, which according to writing time is the main variable influencing the German data. Already there, it was mentioned though that the correlation methods used are not very powerful tools. Therefore, it cannot be decided for sure to what extent writing time explains the German results. Additionally, there is a certain correlation between writing time and amount of word position change ($r_s = .45$, $p < .05$), which suggests that the two measures are not independent. However, this model fits the German data quite well, whereas it explains less well the English results. This finding may lead to the speculation that amount of rearrangement in word order has significance for the transformation of the fairly sophisticated bilingual speaker, but contributes less to the understanding of basic unfamiliarity with German.

Insert Table 7 about here

(4) Number of changed positions of sentence parts: A more appropriate unit of position changes might be the sentence parts. Words are often rearranged within sentences as whole clusters, i.e., as sentence parts, e.g , articles or adjectives are always switched together with the nouns. In the present analysis the number of changes of such sentence parts was enumerated in the same way as for words, counting each sentence part as one position. In case of verbs with auxiliaries, the main verb was considered the important part. The number of sentence part changes summed over six sentences are given in Table 8. Unfortunately, the procedure of enumerating position changes is a somewhat arbitrary but has a crucial impact on the outcome of the correlation. Because the sentences are short, small variations in the assessing procedure have an effect. Under the present condition, the Spearman rank correlation (with correction for ties) between the number of position changes and performance times is $r_s = .26$ ($p < .05$) for the English data and $r_s = .43$ ($p < .01$) for the German data. Thus, this method accounts for the data to about the same extent as the analysis of changes in word position. And again, there is a stronger relationship for the German than for the English data.

Insert Table 8 about here

(5) Base structure analysis: Since the degree of rearrangement in word order which a transformation requires seems to relate to the amount of time which is needed for the transformation, an analysis in terms of "base structure" might be attempted. The base structure, it has been argued, represents the "blueprint" of sentences upon which transformations are applied changing it into various surface structure sentences. For our purpose, the base structure may be understood as that form which has minimal distance to all the possible surface sentences in English or German. Or formulated in terms of word order, the sentence form which requires minimal rearrangement to be transformed into all the possible other sentences is closest to such a base structure and should, therefore, take the shortest time to be formed.

In our design, the following order of increasing word position changes in comparison to all other transformations was observed: GD = CQ < ED = EQ < GP < EP. There is no correlation between this order and the total performance times for the output sentence types (English: $r_s = .09$, $p > .05$. German: $r_s = .44$, $p > .05$). But there is a fairly high correlation, although not significant, with the total performance times for the input sentence types (English: $r_s = .68$, $p > .05$. German: $r_s = .74$, $p > .05$).

In our experiment three types of transformations were used: the transformations into active declaratives, questions, and passive sentences. As it turns out, there is a difference between these transformations. The transformations into passive sentences were found to be hardest, those into declarative were easiest. Especially the German passives took up much more time than the other transformations.

Again, these findings can be related to differences in writing time, since the passive sentences included two more words ("by," "has," or "von," "worden") than the other sentences; i.e., they included five more letters in the English passive and nine more in the German passive sentences. Moreover, for the German Ss, even the passive form is harder to understand than the other forms. Thus, the passive form, indeed, causes many more difficulties.

Footnote

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Table 1

Minimum Group Overlaps in Percentages for Seven Tasks and Two Groups of Ss.

Tasks	Spanish	English
Superordinates	25.8	39.0
Coordinates	31.1	52.1
Similars	21.9	44.6
Contrasts	42.6	52.9
Functions	34.7	46.1
Qualities	22.7	29.5
Parts	20.4	47.6
Average	28.5	44.4

Table 2

Sums of Overlaps between Any One Task and the Remaining Six per S and Stimulus Multiplied by 100

Tasks	1st Span. (Span. Ss)	1st Engl. (Amer. Ss)	2nd Span. (Amer. Ss)	2nd Engl. (Span. Ss)
Superordinates	23.3	16.1	21.1	45.5
Coordinates	45.3	59.9	56.4	67.6
Similars	35.8	51.3	40.8	62.9
Contrasts	24.6	31.0	37.2	34.9
Functions	11.5	7.3	6.9	20.8
Qualities	13.2	5.7	13.9	16.0
Parts	19.6	12.4	19.3	25.5
Σ	173.3	183.7	195.2	273.2

Table 3

Results of Free Associations for Five Testing Conditions

	TTR	PSI	PTS
EE	.55	7	0
GG	.63	16	0
EG	.32	27	56
GE	.32	39	62
FE(w)	.43	38	53
(n)	.57	68	24

Note: The letters in the first column refer to the stimulus and response language respectively: E = English, G = German, F = French, w = with some knowledge of French, n = with no knowledge of French.

TTR = type-token ratios; PSI = % of responses with the same initials as the stimulus; PTS = % of responses identical with translations of stimuli.

Table 4

Results of Restricted Associations for Four Testing Conditions Averaged Over Eight Tasks

	TTR	PFO	PTO
EE	.50	21	20
GG	.55	21	30
EG	.54	14	27
GE	.54	7	20

Note: The letters in the first column refer to the stimulus and response language respectively: E = English, G = German.

TTR = type-token ratios: PFO = % of free associative overlaps; PTO = % of the overlaps of any one task of restricted associations with the other seven.

Table 5

Total Transformation Times for English Data Summed Over 20 Ss and 12 Sentences (in sec.)

		Output						
		English			German			
Input		Declar.	Question	Passive	Declar.	Question	Passive	Total
ENGLISH	Declar.	475.07	488.20	565.19	616.08	633.08	778.53	3556.15
	Question	471.19	488.26	581.19	648.61	652.51	815.08	3656.8
	Passive	492.98	552.45	559.28	658.72	646.29	813.73	3723.45
GERMAN	Declar.	492.40	541.33	599.85	565.10	605.12	758.24	3562.04
	Question	499.69	551.17	605.57	581.66	574.04	782.15	3594.28
	Passive	530.32	572.51	643.35	614.42	658.20	712.73	3731.53
	Total	2961.65	3193.92	3554.43	3684.59	3769.24	4660.46	21824.29

Table 6

Total Transformation Times for German Data Summed
Over 20 Ss and 12 Sentences (in sec.)

		Output						
		English			German			
Input		Declar.	Question	Passive	Declar.	Question	Passive	Total
ENGLISH	Declar.	451.20	471.95	543.80	504.65	529.40	627.35	3128.3
	Question	471.20	471.35	557.95	523.05	538.25	623.40	3185.20
	Passive	500.70	536.25	547.60	518.25	535.35	640.55	3278.70
GERMAN	Declar.	453.00	490.30	548.65	505.10	514.55	597.65	3109.25
	Question	504.20	499.85	570.85	486.10	507.05	628.75	3196.80
	Passive	506.75	543.10	567.35	506.55	530.35	611.10	3265.20
	Total	2887.05	3012.80	3336.20	3043.70	3154.95	3728.80	19163.50

Table 7

Number of Changes in Word Positions for 36 Types of Transformations Summed Over Six Sentences per Cell

Input		Output: English D	English Q	English P	German D	German Q	German P
ENGLISH	D	0	4	18	4	8	16
	Q	4	0	18	8	4	18
	P	18	18	0	18	18	10
GERMAN	D	4	8	18	0	4	14
	Q	8	4	18	4	0	14
	P	18	18	10	14	14	0

Table 8

Number of Changes of Sentence Components for 36 Types of Transformations Summed Over Six Sentences Per Cell

Input		D	Q	P	D	Q	P
ENGLISH	D	0	0	4	2	2	4
	Q	0	0	4	2	2	4
	P	4	4	0	4	4	2
GERMAN	D	2	2	4	0	0	2
	Q	2	2	4	0	0	2
	P	4	4	2	2	2	0

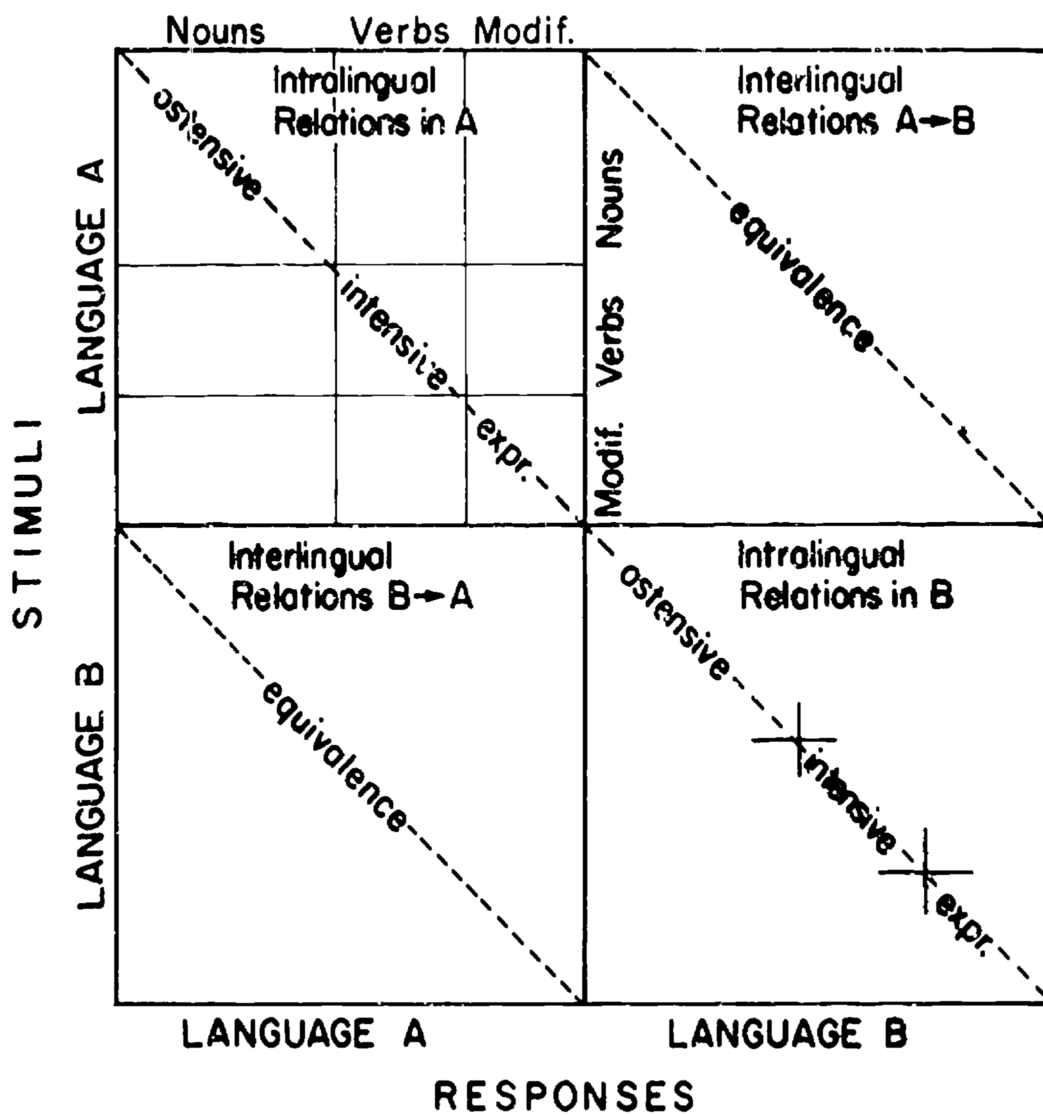

Fig. 1. Matrix of Inter- and Intralingual Relations.

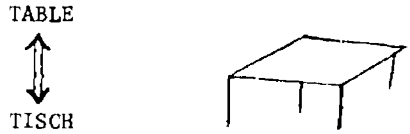

Fig. 2. Equivalence and extralingual relations.

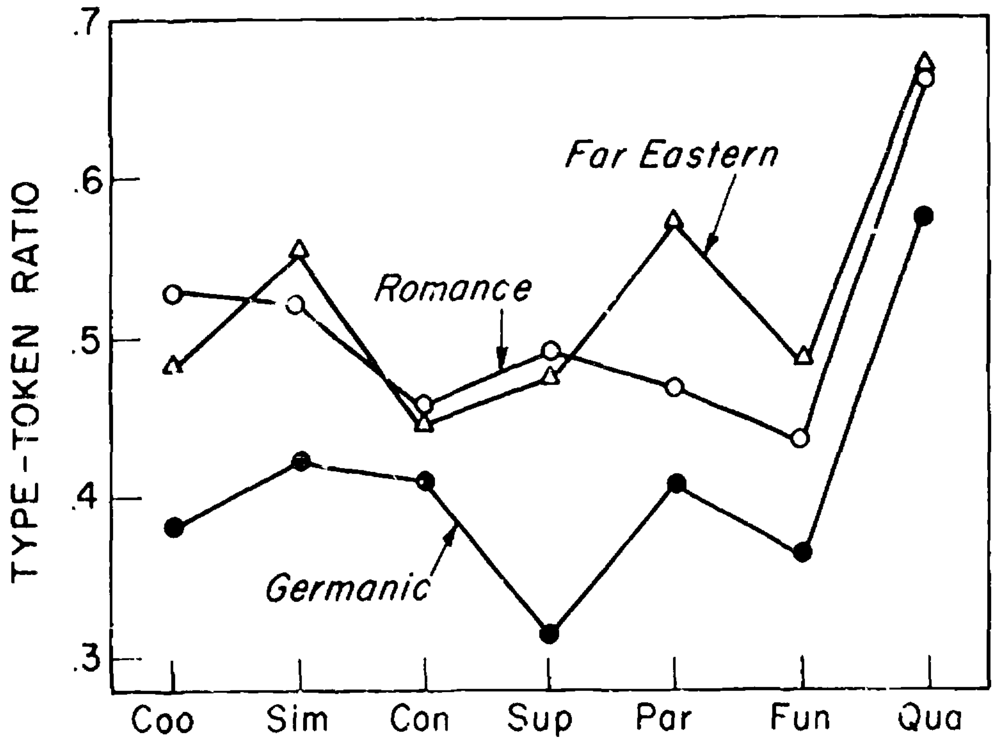

Fig. 3. Average type token ratios for seven types of restricted associations and three language families.

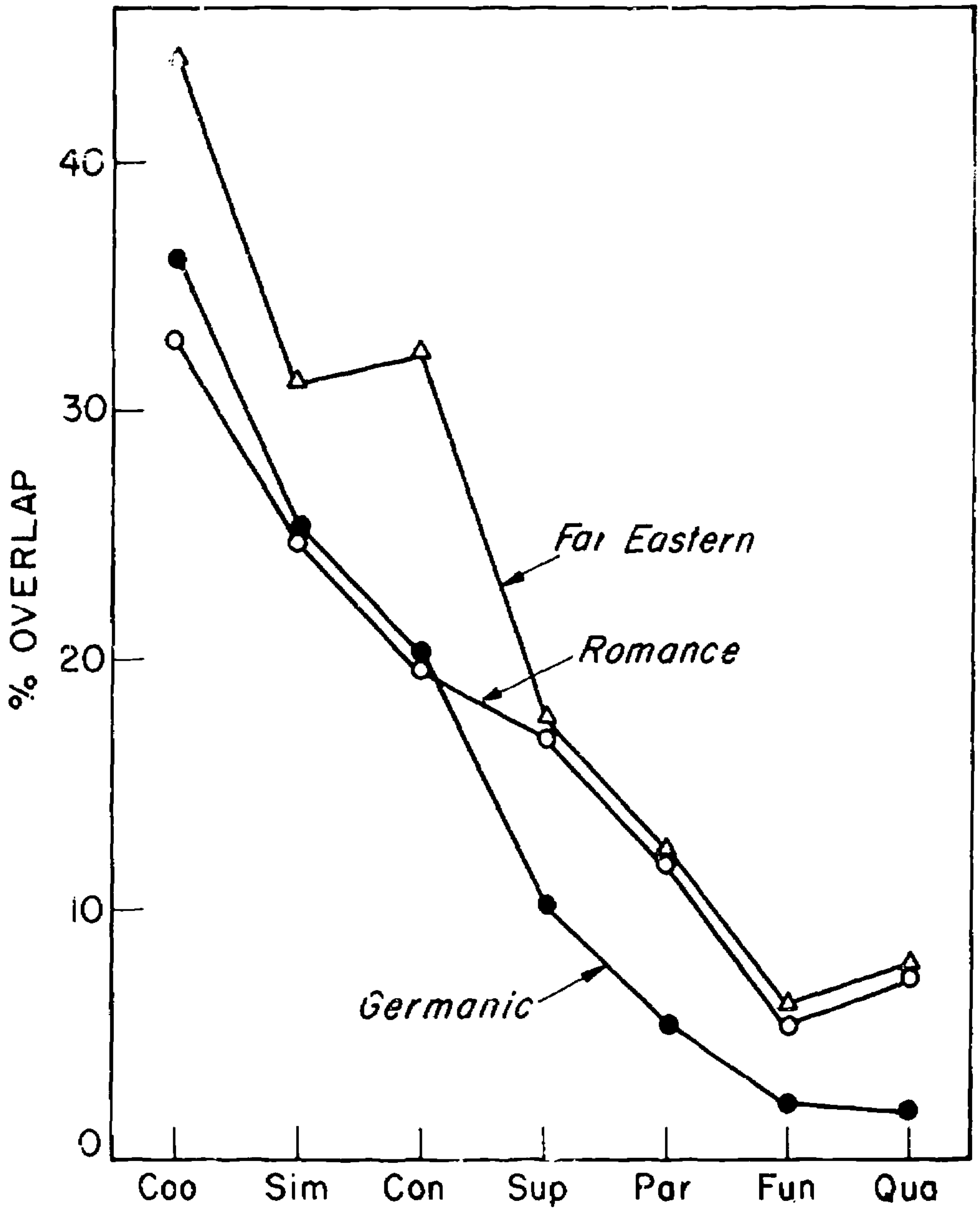

Fig. 4. Average percent overlaps for seven types of restricted associations and three language families.

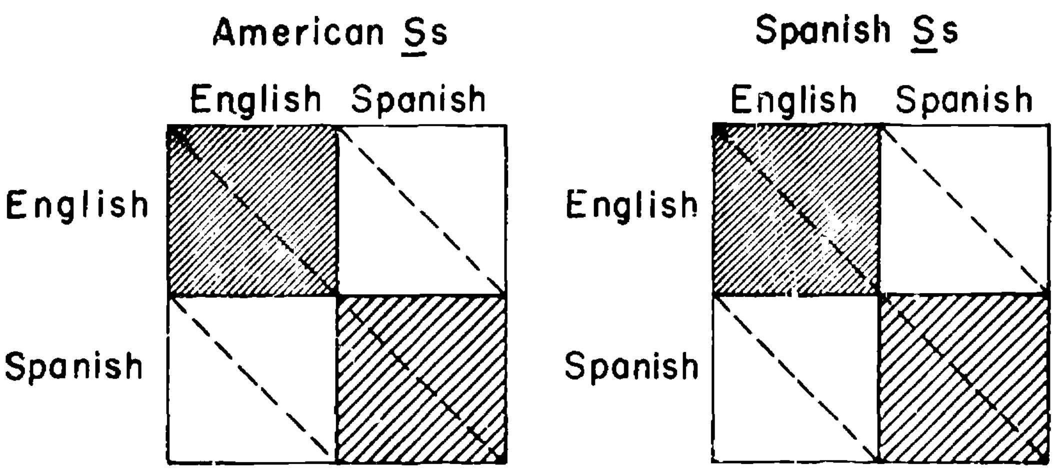

Fig. 5. Predicted familiarity with intralingual relations in English and Spanish for American and Spanish Ss.

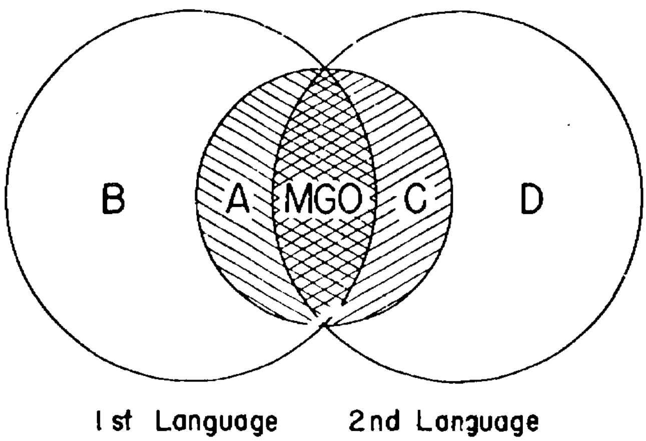

Fig. 6. Subsets of responses given by first and second language learners (MGO = items already acquired by second language learners; A = items already acquired, but to be used more often; B = items not yet used; C = items used too frequently; and D = items not to be used any longer. Both MGO + A + B and MGO + C + D equal 100 percent, respectively; 1st GO - MGO = A; 2nd GO - MGO = C.

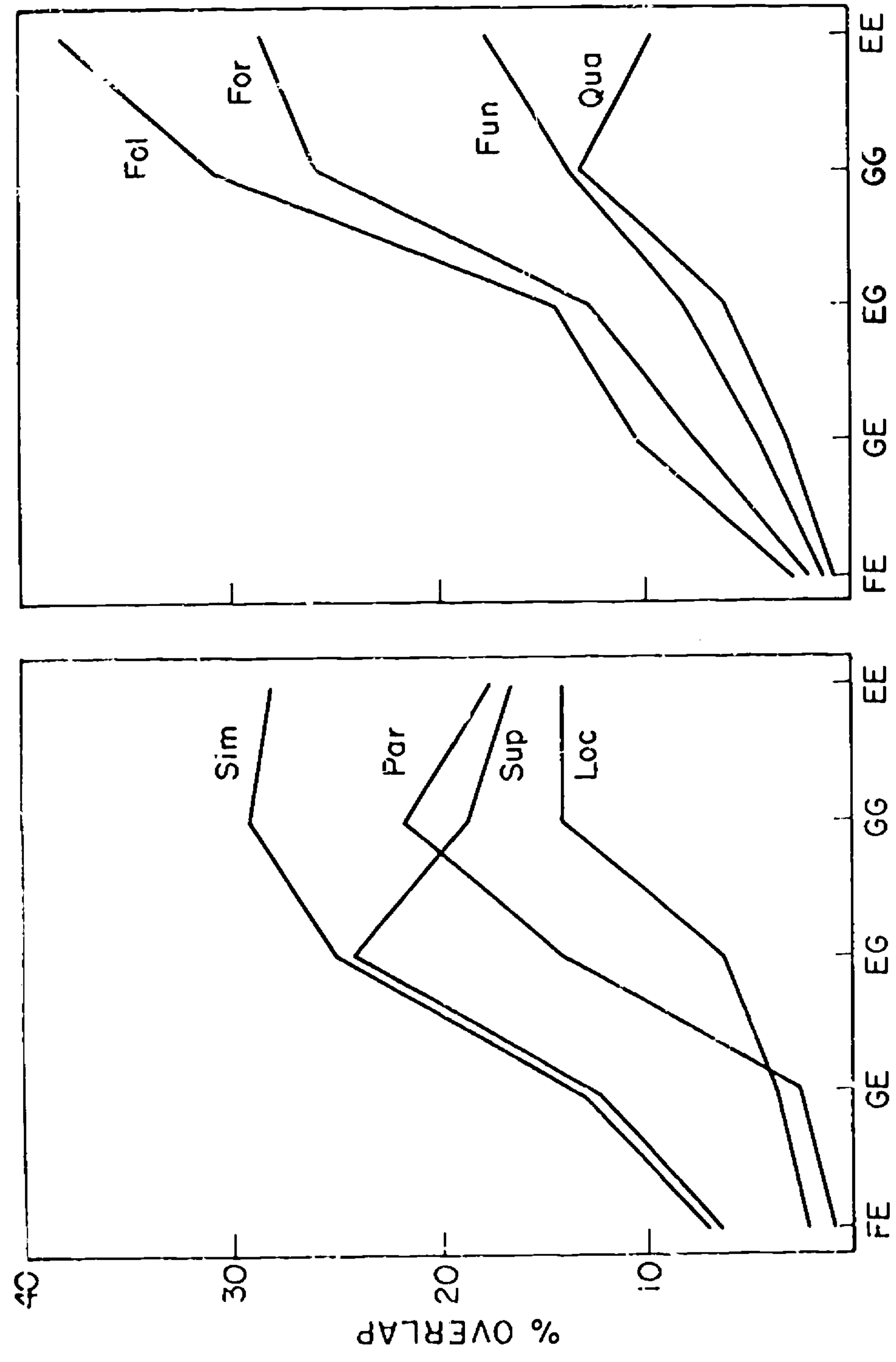

Fig. 7. Percent overlaps between free and eight types of restricted associations for five testing conditions.

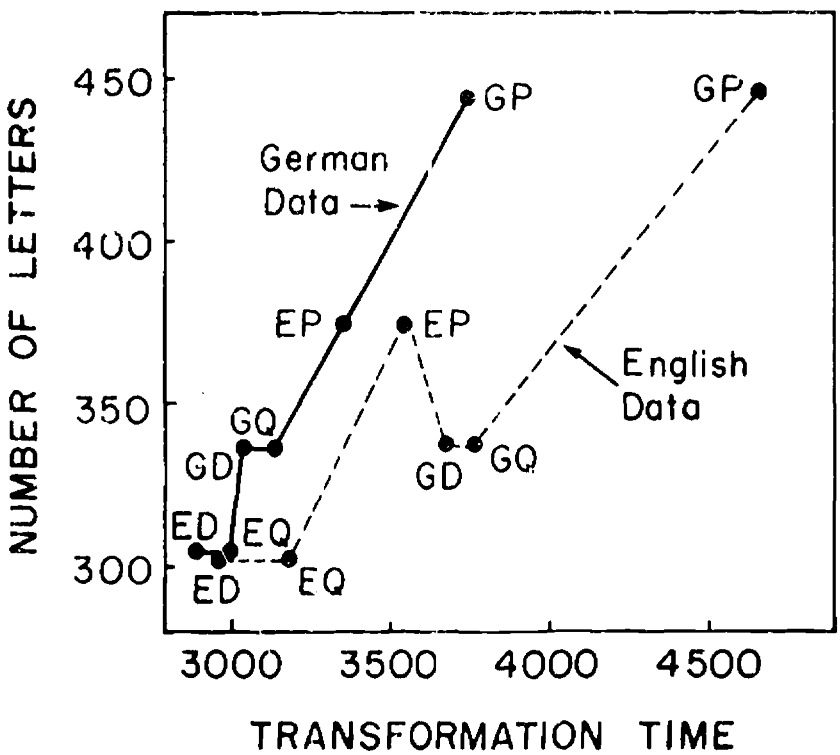

Fig. 8. Number of letters pro sentence type plotted against transformation time.